9

Hybridization Experiments in Rhodeine Fishes (Cyprinidae, Teleostei). Intergeneric Hybrids Obtained from *Acheilognathus lanceolata* × *Rhodeus amarus* and *Rhodeus amarus* × *Acheilognathus tabira*

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(Plate I)

In a previous publication[1] the successful intergeneric hybridization of female *Rhodeus ocellatus* (Kner) and male *Acanthorhodeus atremius* (Jordan & Thompson), both of Japanese origin, was reported. All 15 hybrid specimens obtained were males. A number of these were crossed back to the maternal species, *R. ocellatus,* and the offspring obtained from this combination consisted of interfertile males and females. This paper deals with results obtained by crossing (1) female *Acheilognathus lanceolata* (Temminck & Schlegel) of Japanese origin with male *Rhodeus amarus* (Bloch) of western Europe, and (2) female *Rhodeus amarus* with male *Acheilognathus tabira* (Jordan & Thompson) of Japanese origin. Berg (1948-1949) considered *R. amarus* a subspecies of *R. sericeus.* Recently, however, Holčík (1959) has revised the taxonomic status of the different forms of European bitterling which had been considered to represent only minor variations within the taxon *R. sericeus amarus.* As a result of extensive comparative investigations he proposed to subdivide the group into three lower taxonomic units, *"Rhodeus sericeus amarus amarus* (Bloch)" which inhabits the system of the river Elbe in Germany, *"Rhodeus sericeus amarus danubicus"* which populates the Danube river in Austria, and *"Rhodeus sericeus amarus svetovidovi"* occurring in the Dnepr and Bug rivers in the U.S.S.R. The form that has been used in the present investigation is identical with the form called *"R. sericeus amarus amarus"* by Holčík.

Hybrids between *A. lanceolata* and *R. amarus*

Because of the incompatibility of their spawning behavior, *A. lanceolata* and *R. amarus* are incapable of interbreeding under laboratory conditions with the aid of freshwater mussels. Therefore, artificial insemination was applied in the usual way.

Thirty-four eggs of one female *A. lanceolata* were inseminated with sperm of one male *R. amarus.* Fertilization was complete. All the larvae hatched and 33 of them reached the free-swimming stage within 24 days. Twenty arbitrarily selected fry were raised to the adult stage. A representative adult hybrid specimen is illustrated in Plate I, Fig. 3, together with specimens of the parental species.

All hybrids showed a male phenotype and displayed full nuptial colors in the breeding season. Tubercles were abundant on top of the snout. Spawning behavior, however, was poorly developed. The quantity of milt produced by stripping was very small, and from this it is concluded that spermatogenesis was impaired. All hybrids were fairly uniform in size. With respect to body size they were, however, not intermediate between the parental species. They attained the body lengths of the maternal species, *A. lanceolata,* which is larger than *R. amarus.* The hybrids were more resistant to infectious diseases than either parental species. In their general appearance and liveliness they clearly demonstrated the presence of hybrid vigor.

Hybrids between *R. amarus* and *A. tabira*

In *R. amarus* and *A. tabira,* the patterns of spawning behavior are very similar. Therefore the interbreeding of both species with the aid of freshwater mussels was attempted under laboratory conditions.

One male *A. tabira* and two female *R. amarus* were placed together in an aquarium provided with three South African najads, *Aspatharia wahlbergi* (Krauss). After five weeks, five fry were seen swimming near the surface of the water. Only one specimen reached the adult stage. It is illustrated in Plate I, Fig. 6, together with specimens of the parental species.

The hybrid was more or less intermediate between the parental species and showed a male phenotype. In the breeding season it displayed full nuptial colors and spawning behavior. The red pigment, which is present in male *R. amarus* but lacking in *A. tabira,* was also absent in the hybrid. Tubercles were abundant on top of the snout, but the quantity of milt produced by means of stripping was extremely small.

A taxonomic description of the two hybrid forms recorded here will be published separately.

Summary

With the aid of artificial insemination, intergeneric hybrids between female *Acheilognatus lanceolata* of Japanese origin and male *Rhodeus amarus* from western Europe were obtained. All hybrids were males. They displayed full nuptial colors in the breeding season, but spawning behavior was poorly developed and milt production was impaired.

The interbreeding of *Rhodeus amarus* and *Acheilognathus tabira* from Japan with the aid of mussels was successfully carried out under laboratory conditions. Only one hybrid reached the adult stage, however. It appeared to be a male. In the breeding season it displayed full nuptial colors and spawning behavior, but its production of milt was very limited.

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EXPLANATION OF THE PLATE

Plate I

Fig. 1. Female *Acheilognathus lanceolata.*

Fig. 2. Male *Rhodeus amarus.*

Fig. 3. Adult intergeneric hybrid between female *A. lanceolata* and male *R. amarus.* Standard lengths: 74, 56 and 105 mm.

Fig. 4. Female *Rhodeus amarus.*

Fig. 5. Male *Acheilognathus tabira.*

Fig. 6. Adult intergeneric hybrid between female *R. sericeus amarus* and male *A. tabira* Standard lengths: 55, 62 and 75 mm.

[1]Zoologica, Vol. 46 (2): 25-26, 1961.